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CHARACTERISATION OF BACKGROUND BIOLOGICAL AEROSOL

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Representative fluorescence excitation/emission spectra are presented for both background and polluted conditions. In addition, mass distributions of both background and polluted air episodes at the Mace Head site are also presented.

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CHARACTERISATION OF BACKGROUND BIOLOGICAL AEROSOL

Abstract

Sampling of ambient air using a glass cyclone system for fluorescence background determination is described. Weekly samples were taken at the University College Galway's atmospheric research field station at Mace Head, on the west coast of Ireland. The bioaerosol sampling system and procedures used have previously been discussed in the 1st Interim Report. Use is made of a fluorescence protocol developed in the ERDEC Laboratories.

Representative fluorescence excitation/emission spectra are presented for both background and polluted conditions. In addition, mass distributions of both background and polluted air episodes at the Mace Head site are also presented.

1. Introduction

The atmospheric research station at Mace Head offers an ideal remote location for bioaerosol sampling that is virtually free of airborne pollutants. The prevailing wind flow across Ireland is out of the southwest from the Atlantic ocean which ensures that the atmospheric aerosol reaching western Ireland usually is a background aerosol, with few man made or local influences. As a region where natural aerosols are well characterised, Mace Head provides excellent clean baseline conditions against which detection of natural or man made simulant bioaerosols have the highest probability of being detected. Mace Head also offers the opportunity to study European continental emissions when the winds favor transport from that region.

2. Aerojet Glass Cyclone Sampler

The Aerojet General glass cyclone currently in use at Mace Head (made available by the Hampshire Glassware company) has been chosen for it's excellent performance. There are two criteria to be considered when discussing the overall performance of a bioaerosol sampler, (a) collection efficiency and (b) bioefficiency. The glass cyclone sampler has a high sampling efficiency which is reasonably independent of wind speed, aerosol diameter and

sampler orientation and has been proven to be a successful sampler for the collection of bioaerosol material.

3. Bioaerosol Fluorescence Determinations

Based on the fact that natural fluorophores occur intriniscally in all biological molecules, primary fluorescence measurements of the bioaerosol samples have been determined using a Perkin Elmer LS 50B fluorimeter available at University College Galway. The protocol used for fluorescence determinations and the wavelength values for the selected excitation/emission scans have been documented in the 1st Interim report.

4. Background Aerosol Characterisation

Representative emission spectra obtained from three hourly bioaerosol samples at Mace Head are shown in Figure 1 through Figure 3. These spectra are based on the Summer months of July and August 1996 and the Autumn months of September and October 1996 and include data from marine (wind sector 180-300°), and continental (wind sector 45-135°) air masses (Table1.).

Table 1. Bioaerosol measurement periods.

Season	Date	Wind Sector
	07/10/96	Marine
Summer	07/17/96	Continental
	08/01/96	Marine
	09/17/96	Continental
Autumn	09/26/96	Marine
	10/24/96	Marine

Spectra have been grouped by three characteristic excitation wavelengths 282, 350 and 450 nm, corresponding to the fluorescent amino acids, (excitation-emission maxima ~ 280/350 nm), the reduced nicotinamide adenine dinucleotides (excitation-emission maxima ~ 340/450 nm), and the flavin compounds, (excitation-emission maxima ~ 450/520 nm). Back trajectory

data for all selected dates are displayed in Figure 5 (a) to Figure 5 (f), courtesy of Peter Lynch and Liam Campbell at Met Éireann.

Fluorescence intensity values at the excitation wavelength 282 nm are highest on 07/10/96 (Figure 1 (a)), decreasing gradually from August to October (Figure 1 (c), 1 (f)). Values are particularily low on the 09/26/96 (Figure 1 (e)) and are less intense than continental values on the 09/17/96 (Figure 1 (d)). Intensity values at excitation 350 nm decrease significantly from July (Figure 2 (b)) to September (Figure 2 (d)) and fall to zero intensity by October (Figure 2 (f)). July 17th (Figure 2 (b)) continental values are higher than July 10th (Figure 2 (a)) marine values. Intensity values at 450 nm, are near zero from September (Figure 3 (d)) onwards, and similarly to excitation at 350 nm, the July 17th (Figure 3 (b)) continental values are higher than the July 10th (Figure 3 (a)) marine values. The fluorescence signal from the clean background sector is lower than from polluted continental air, on intercomparing adjacent sampling periods.

Aerosol particle mass concentration data corresponding to the Summer (July, August) cyclone sampling dates are shown in Figure 4 (a) to Figure 4 (c). This data has been derived from aerosol particle size distribution data collected using a TSI aerodynamic particle sizer. The calculated mass concentrations from the size distribution data (using a particle density of 1.79 g cm^{-3}) for the three periods of 07/10/96 (marine), 07/17/96 (continental) and 08/01/96 (marine) were 19.33 μg m^{-3}, 21.19 μg m^{-3}, and 27.14 μg m^{-3} respectively.

Figure 1 (a) 07/10/96 Marine

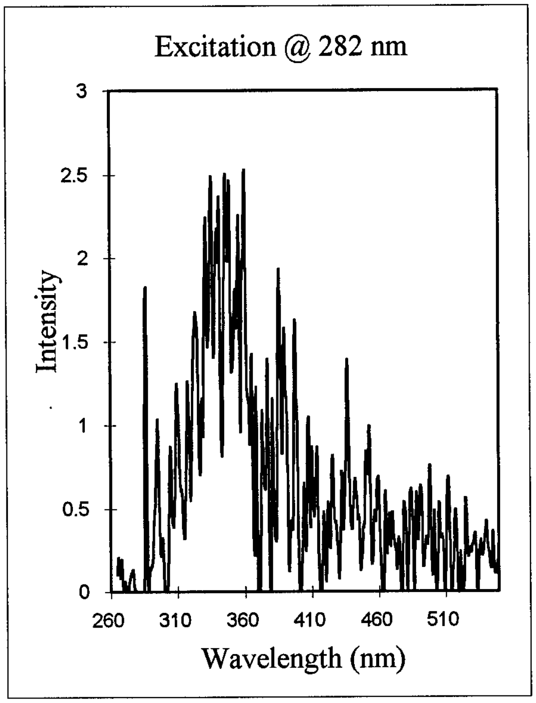


Figure 1 (b) 07/17/96 Continental

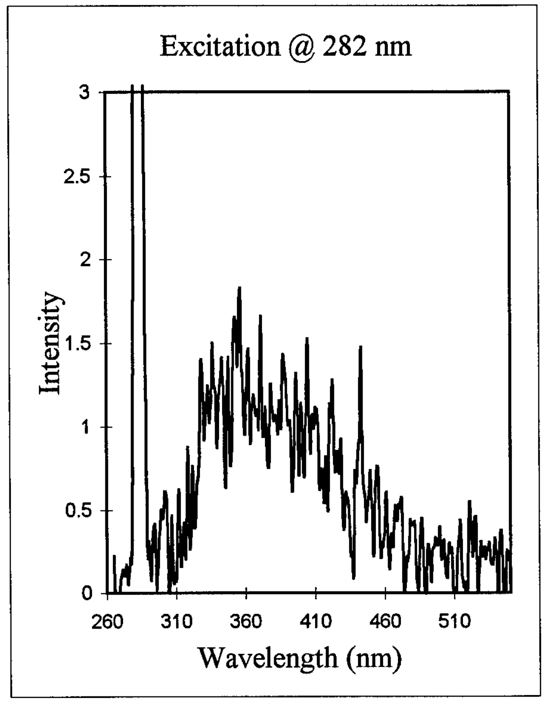


Figure 1 (c) 08/01/96 Marine

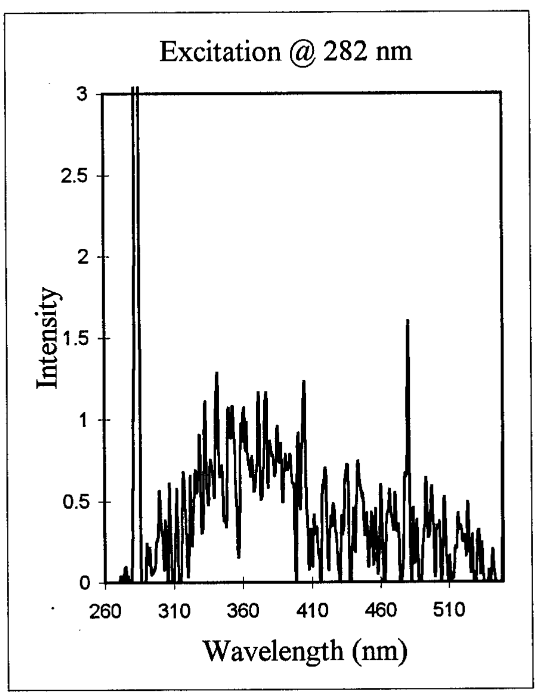


Figure 1 (d) 09/17/96 Continental

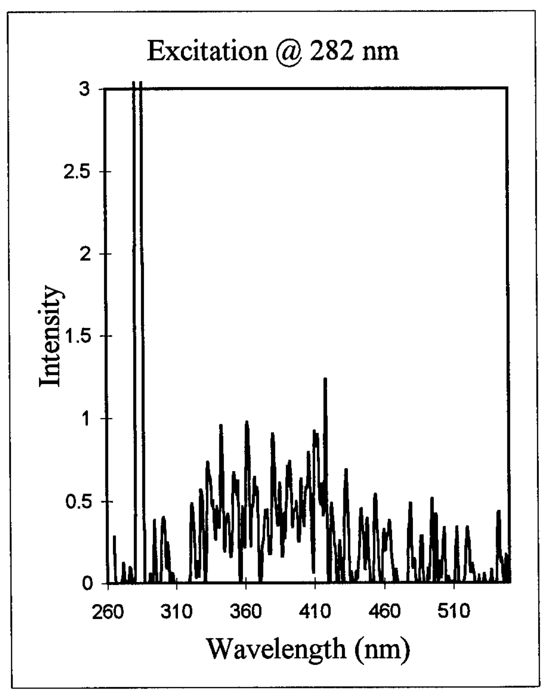


Figure 1 (e) 09/26/96 Marine

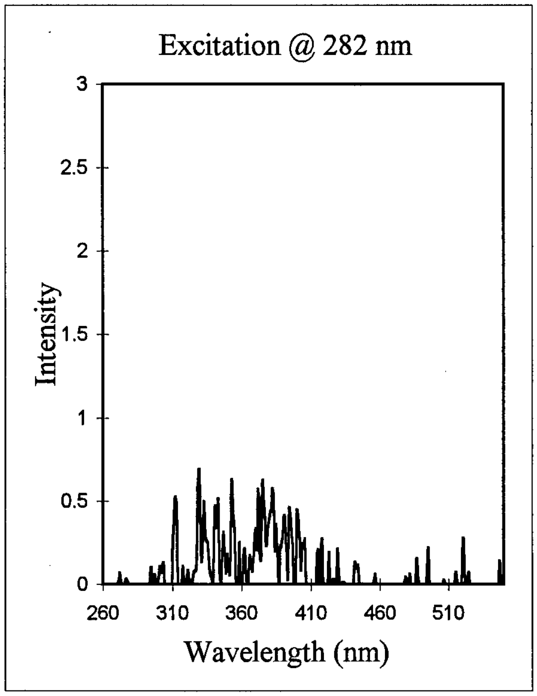


Figure 1 (f) 10/24/96 Marine

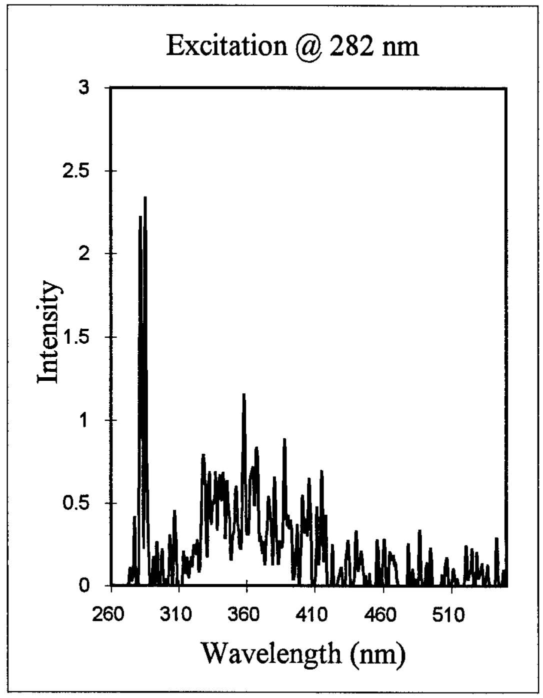


Figure 2 (a) 07/10/96 Marine

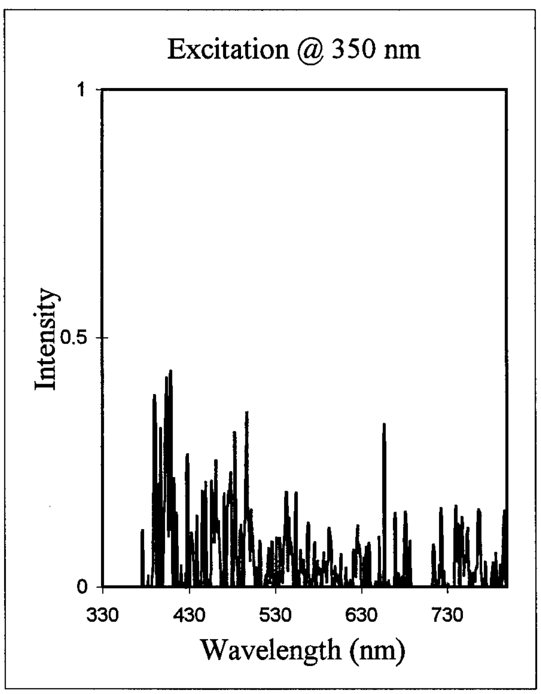
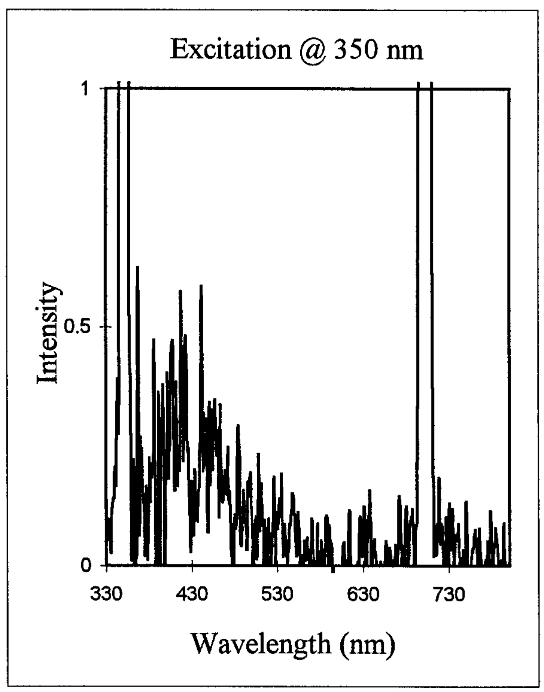


Figure 2 (b) 07/17/96 Continental



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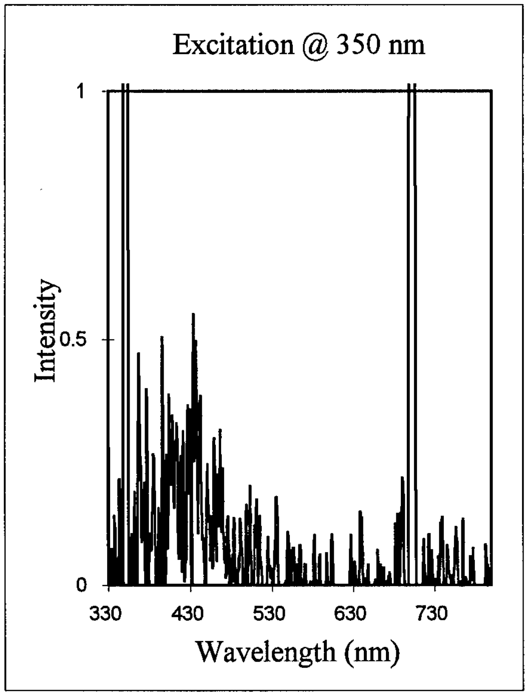

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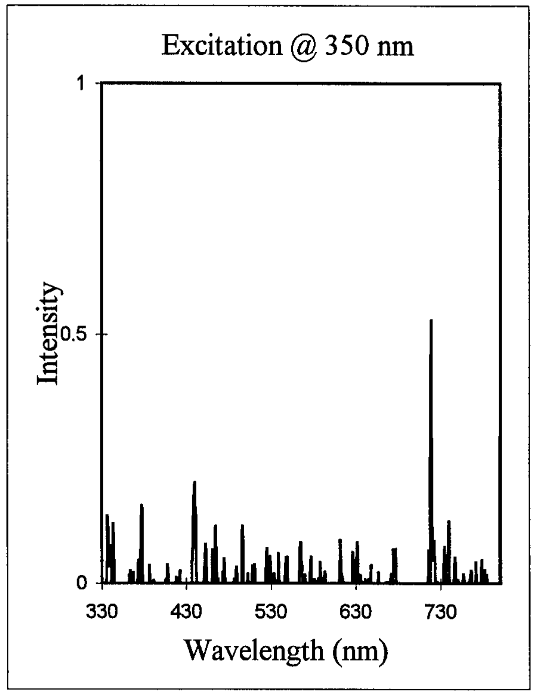

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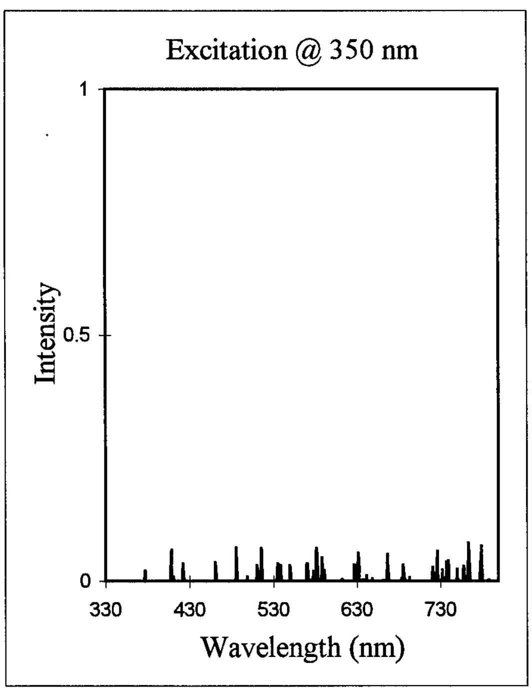


Figure 2 (f) 10/24/96 Marine

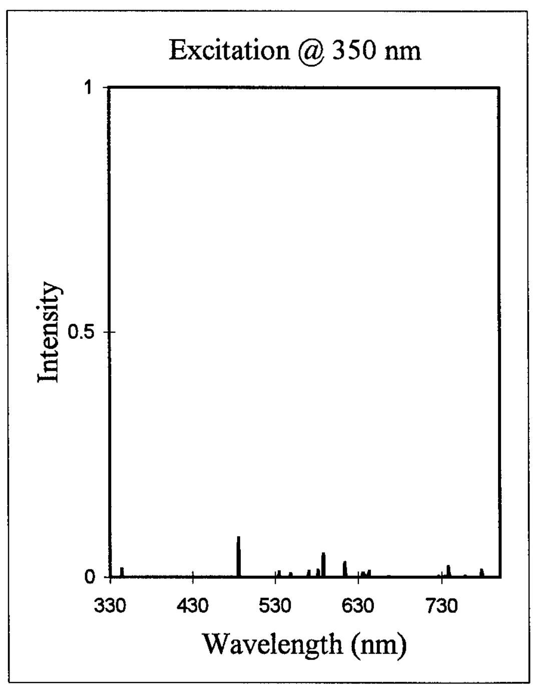


Figure 3 (a) 07/10/96 Marine

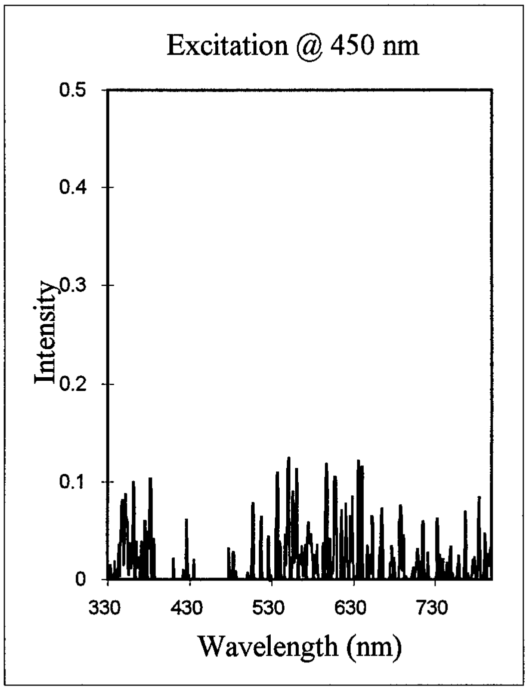


Figure 3 (b) 07/17/96 Continental

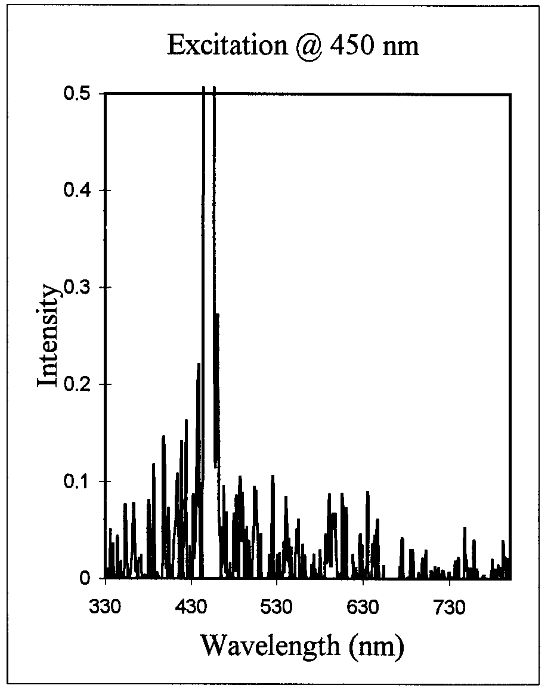


Figure 3 (c) 08/01/96 Marine

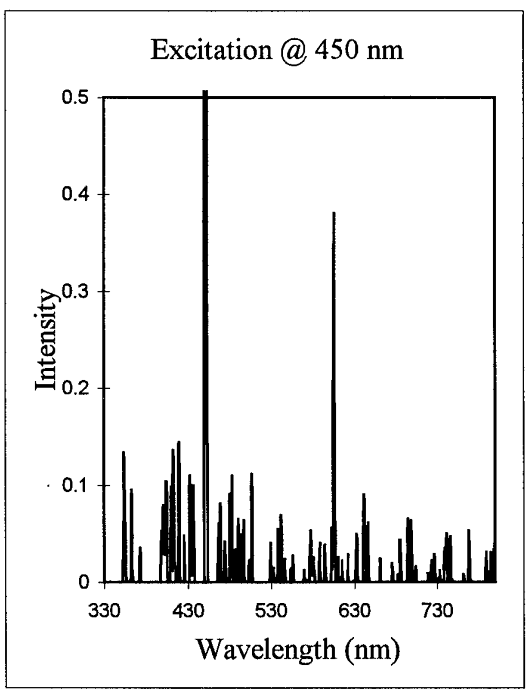


Figure 3 (d) 09/17/96 Continental

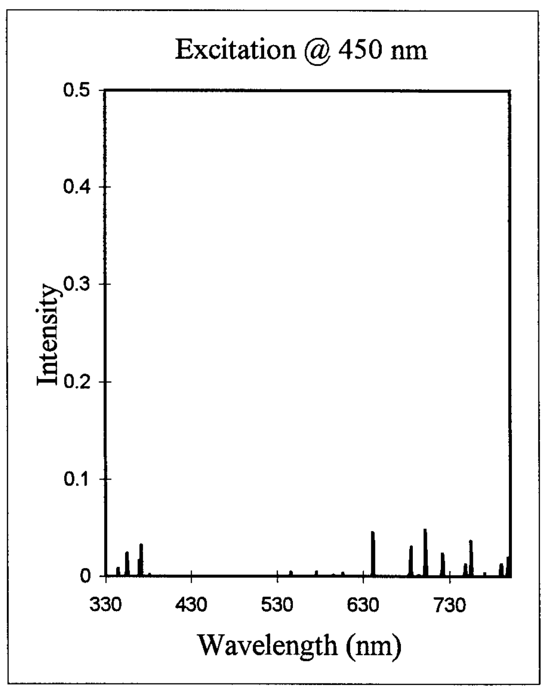


Figure 3 (e) 09/26/06 Marine

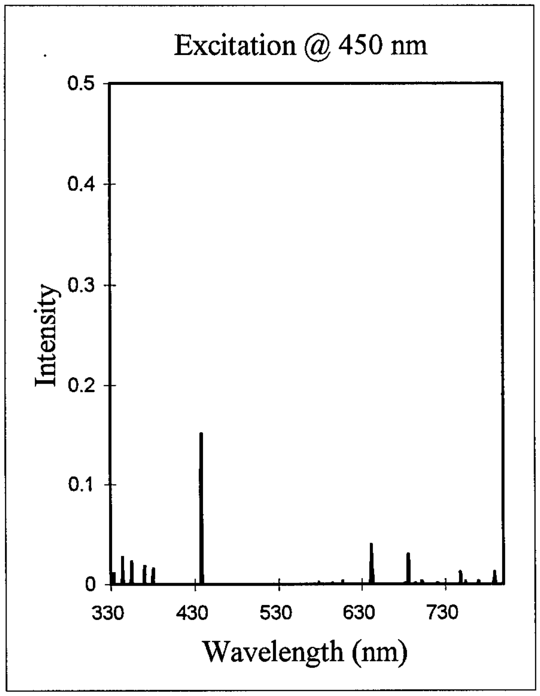


Figure 3 (f) 10/24/96 Marine

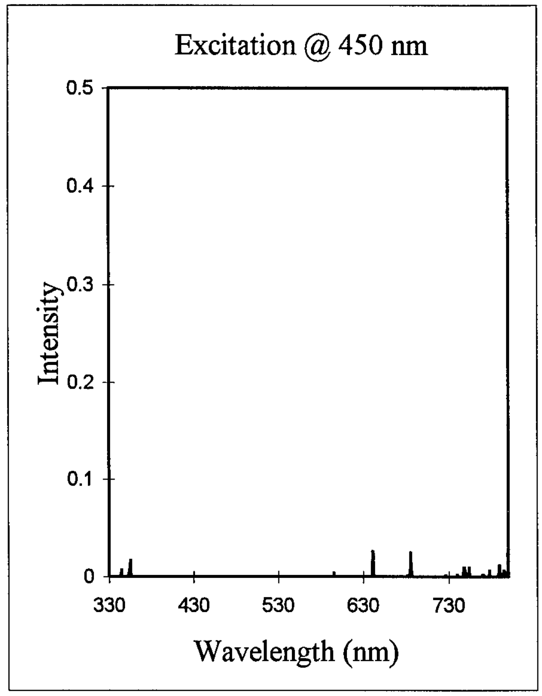
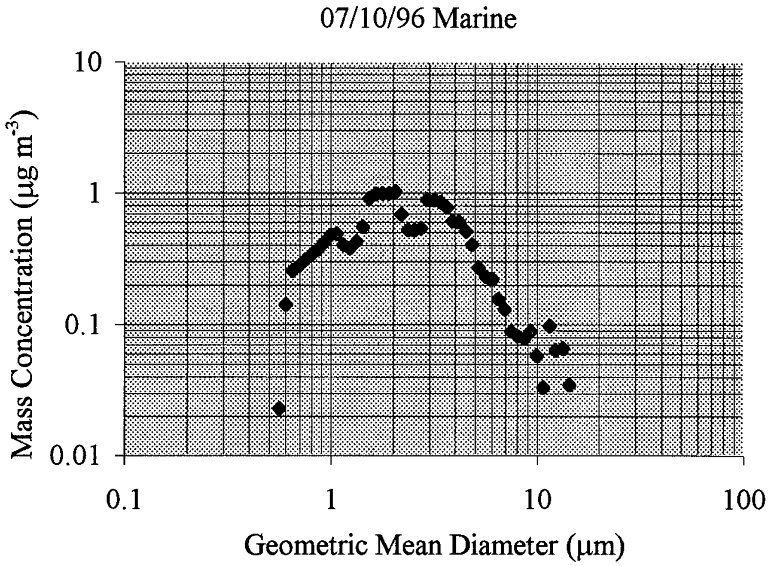


Figure 4 (a)



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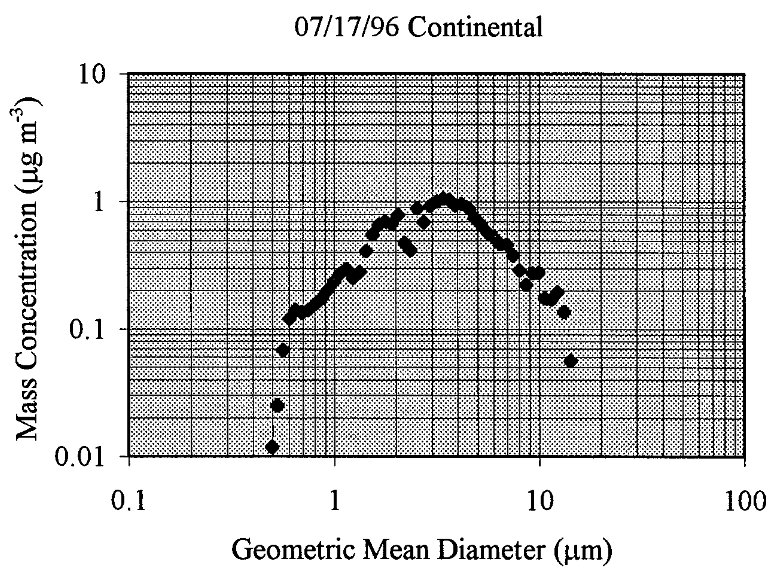


Figure 4 (c)

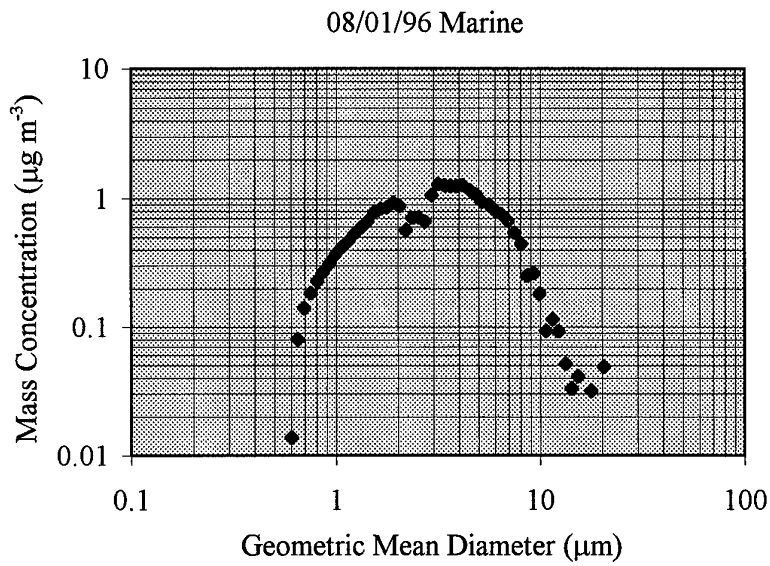
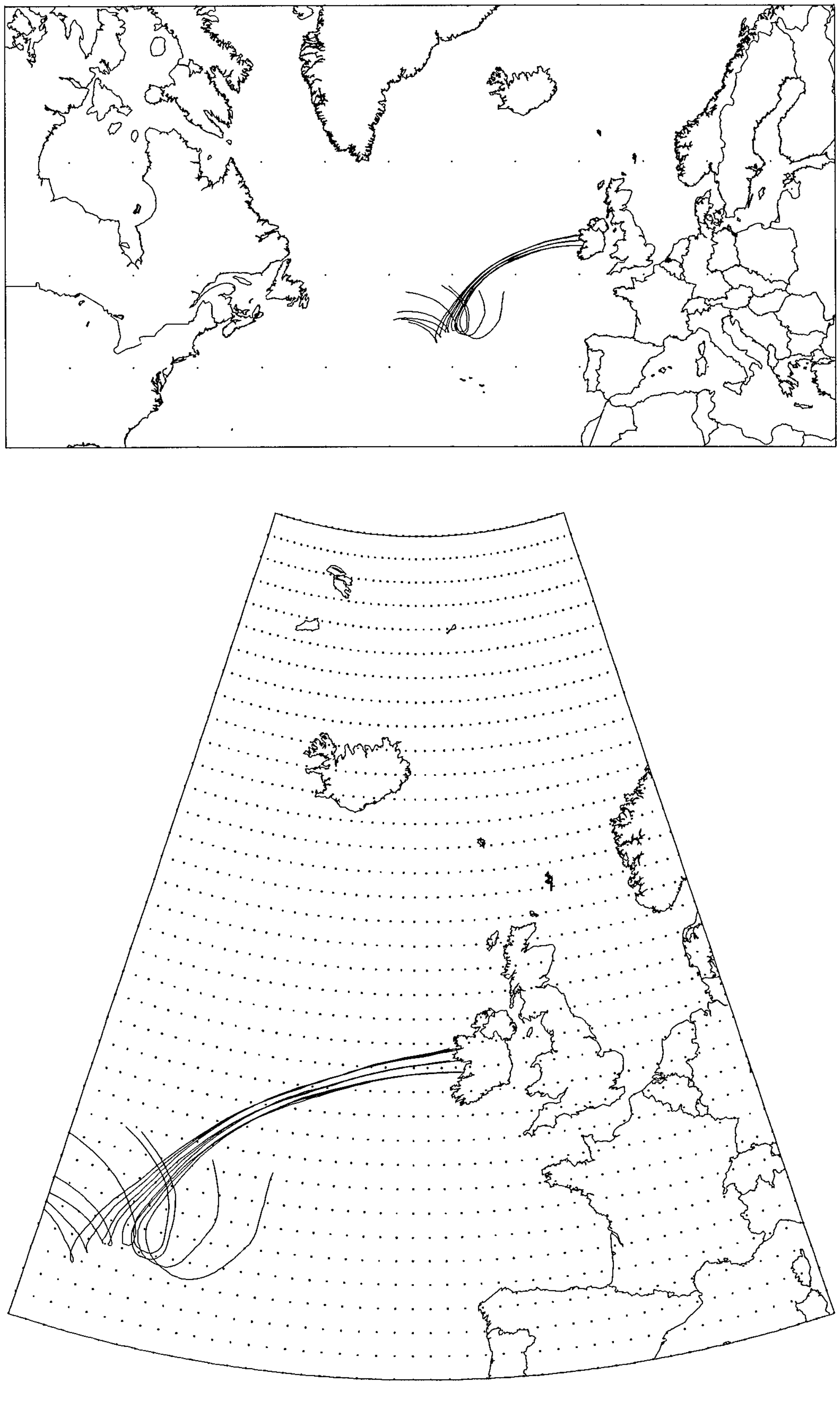
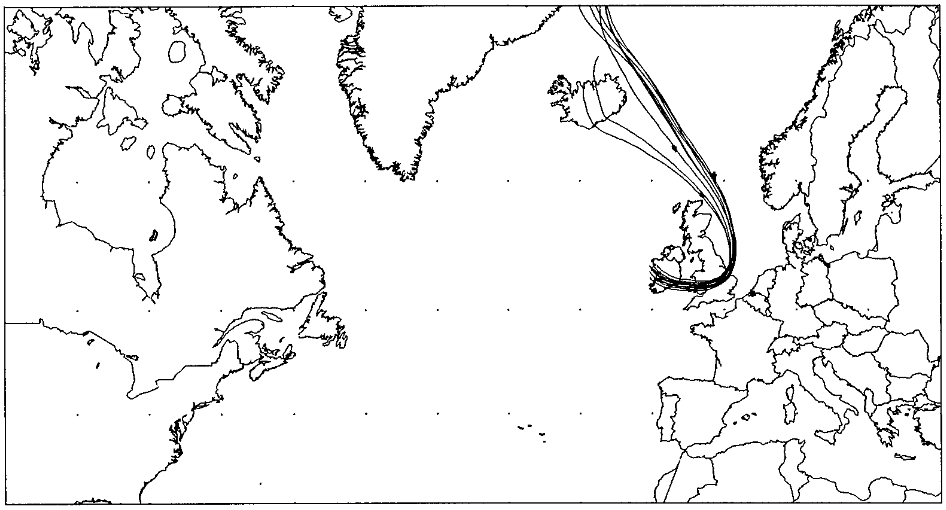

08/01/96 Marine
10
1
0.1
0.01
Mass Concentration (μg m-3)
0.1
1
10
100
Geometric Mean Diameter (μm)

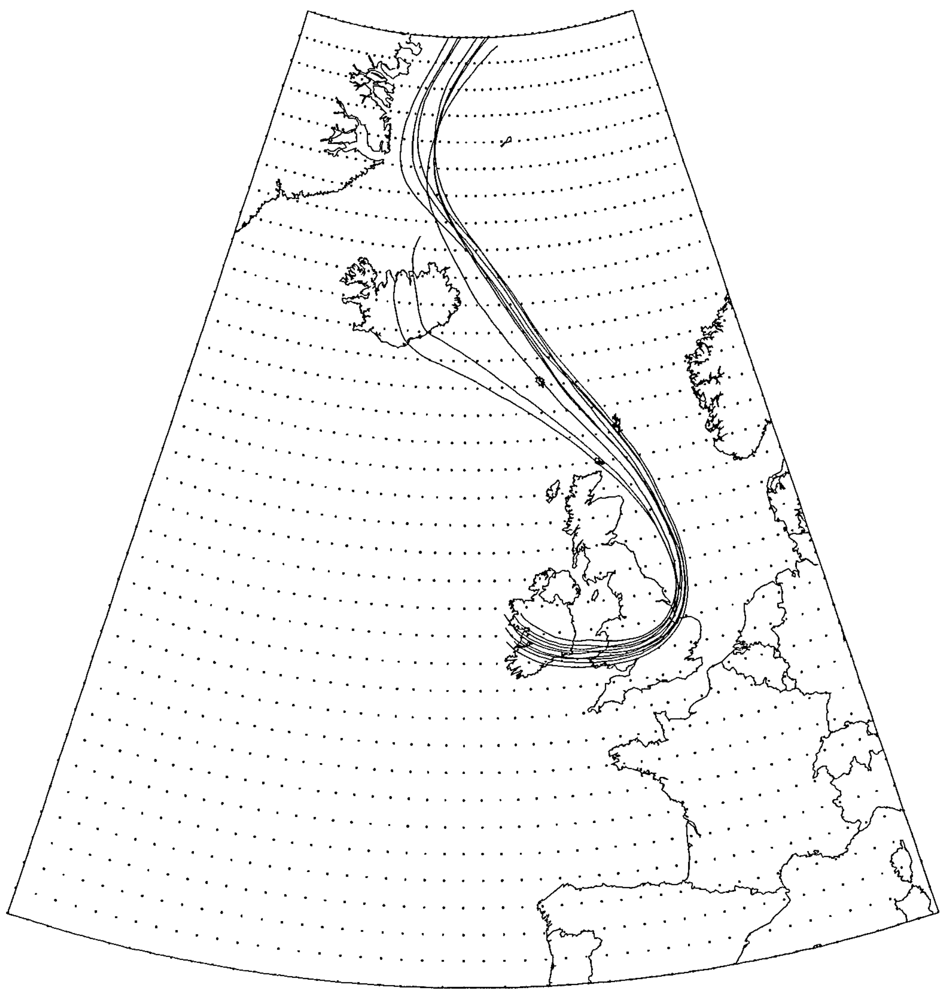
Figure 5 (a)



10 July 1996

Figure 5 (b)





17 July 1996

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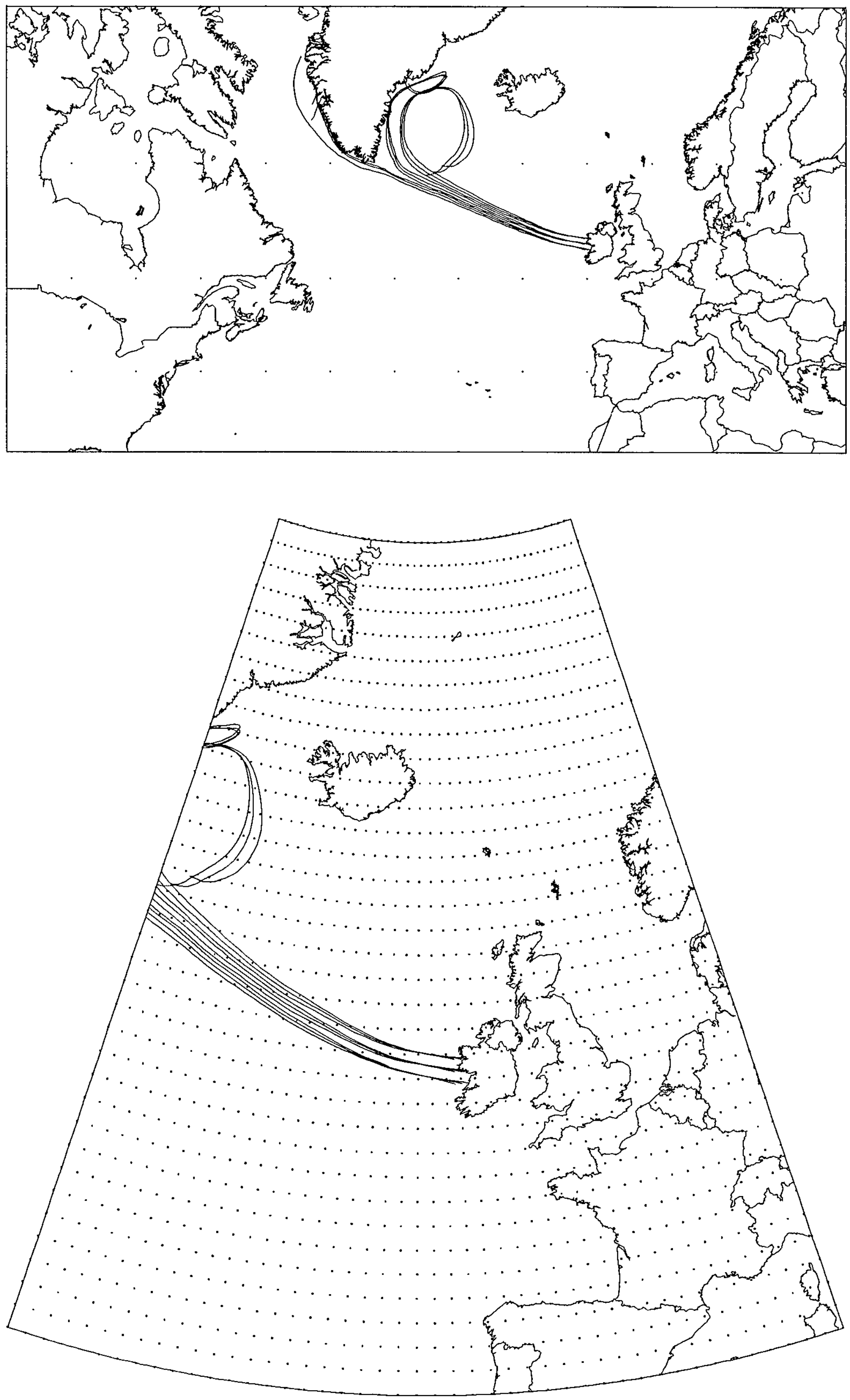

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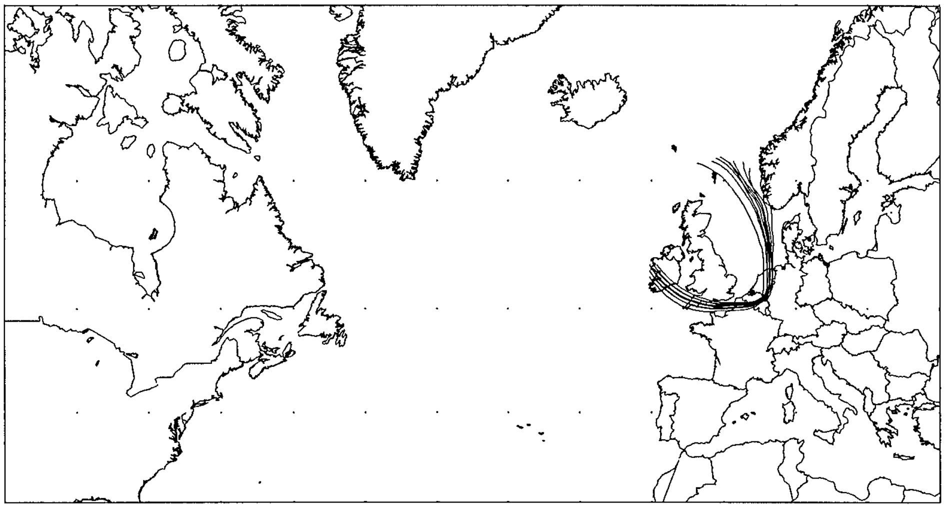
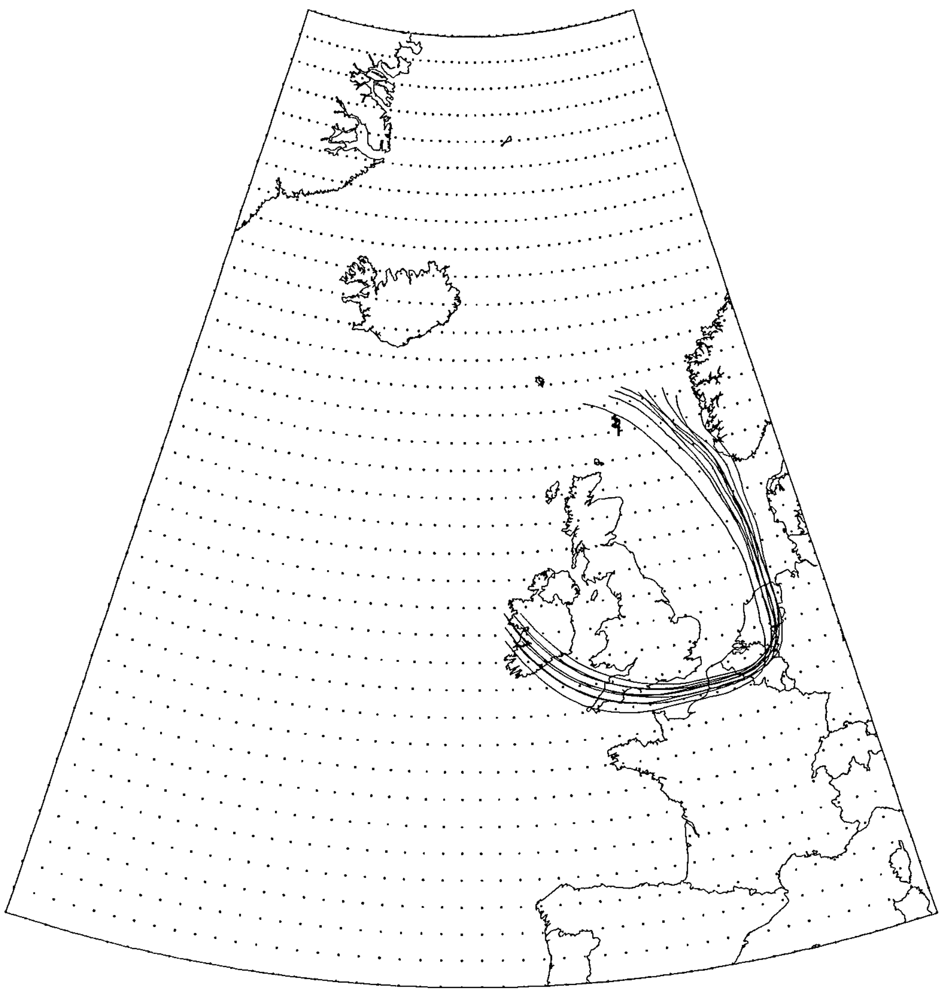
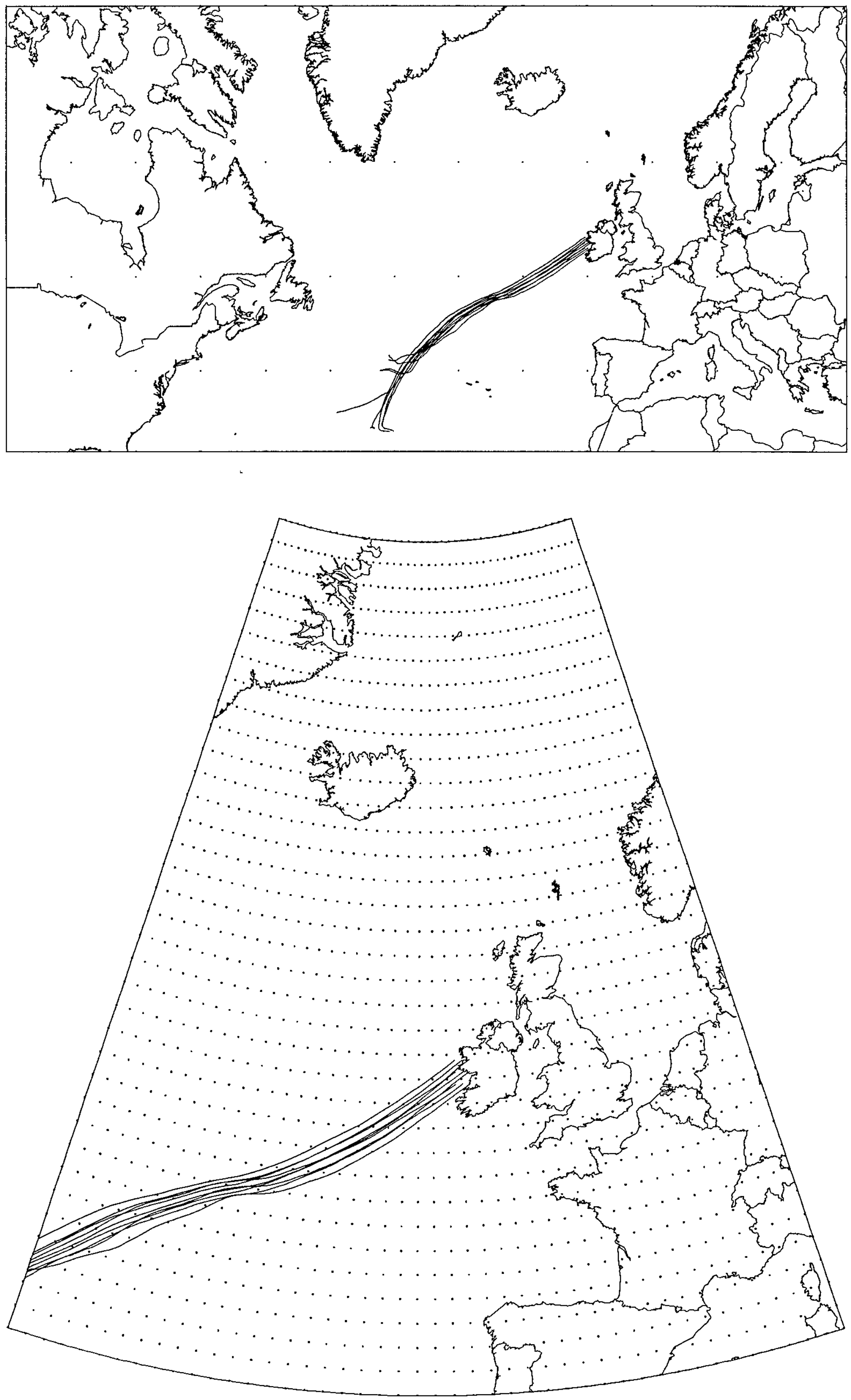




17 September 1996

Figure 5 (e)



26 September 1996

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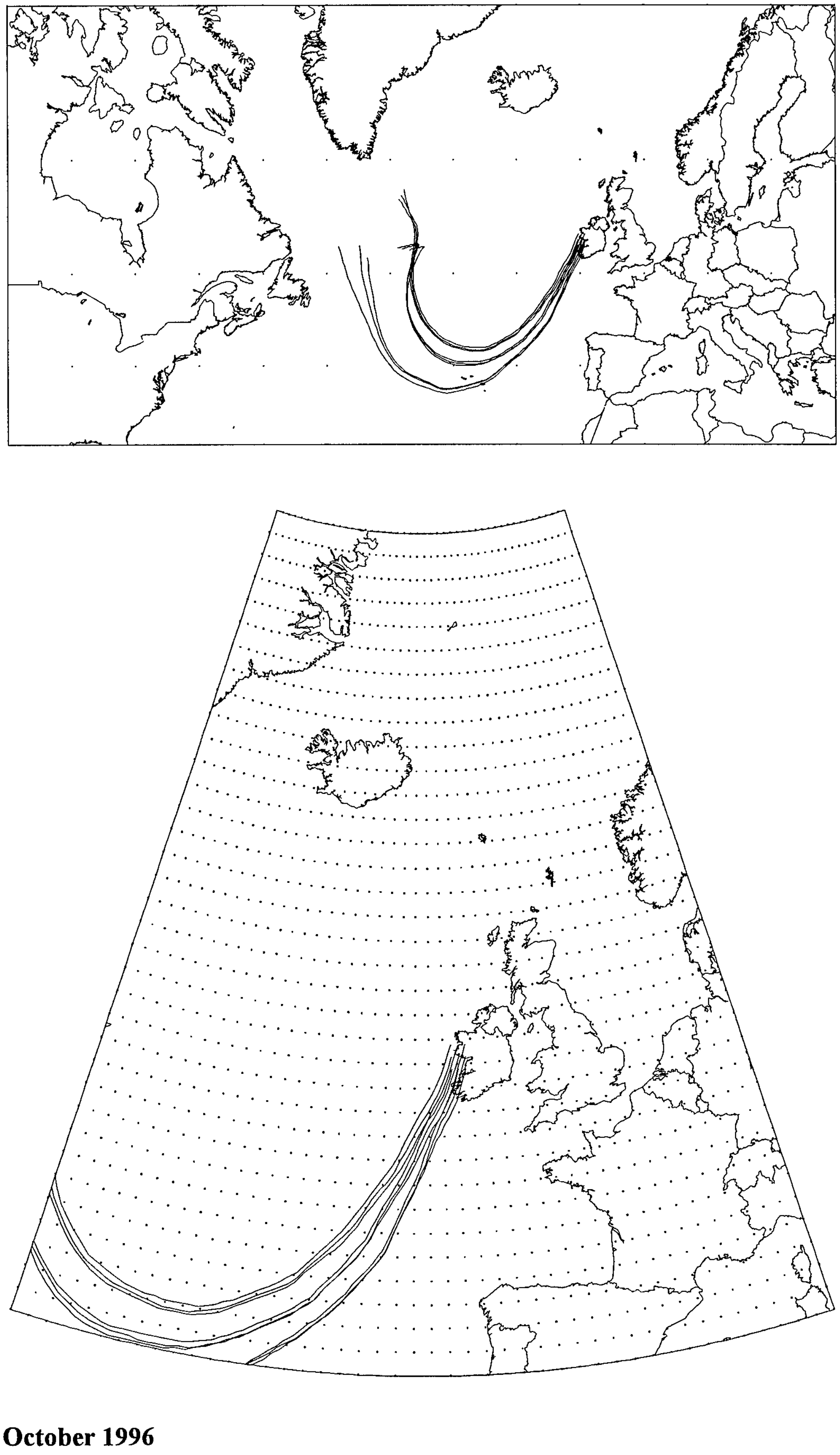

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